

TALES FROM A SPECIES' CRYPT

A frozen graveyard of Rocky Mountain locusts, historical research, and ecological sleuthing reveal a remarkable story that causes us to pause and question, What makes a species real?

## story

**I**N YOUR DREAM A BLIZZARD SWEEPS over the horizon, the sky fills with swirling flakes. But the fields are green and the breeze is hot. As you wrestle with the incongruity, the sparkling snowflakes transform into voracious locusts—and your disbelief transforms into terror. A fluttering insect strikes your face, then ten pelt your body, and soon hundreds envelop you in a vortex driven by papery wings rather than a howling wind. Through the maelstrom you see your crops melt away beneath a bristling blanket of locusts. The horrid creatures fill the air, cling to your hair, work their way under your clothing. You would scream in rage and terror, but you're suffocating. Sucked into this

● BY JEFFREY LOCKWOOD

demented whirlwind, you flail at your tormentors, waking yourself from the nightmare.

But there was no waking from this horrifying vision if you'd been living on the Great Plains of North America in the 1800s. Today, we can only imagine the fear and confusion that arrived with swarms of the Rocky Mountain locust (*Melanoplus spretus*); the scale of life was beyond our modern experience. The swarm of 1875 was the largest congregation of animal life in recorded history: 2,896 km long and 177 km wide. This torrent of insects eclipsed the sun for five days, a superorganism composed of 3.5 trillion locusts, the approximate number of cells in a human body. The swarm outweighed a human being to the same degree that the biomass of a whale exceeds that of a mouse. This metabolic wildfire raged across the Great Plains, leaving hungry and dispirited pioneers in its wake. More than 150,000 settlers were pushed to the edge of famine. In what became the most massive relief effort in the young nation's history, the U.S. Army distributed nearly 2 million food rations to relieve the suffering.

Swarms like this—on smaller, but still remarkable, scales—are part of the life cycle of locusts around the world. At low population densities, these insects behave like typical grasshoppers. But when crowded, this insectan Dr. Jekyll transmogrifies into Mr. Hyde. The changelings aggregate in unruly mobs, feed in preference to mating, grow longer wings and darkened bodies, and erupt into rapacious swarms. However difficult it is to imagine being engulfed by locusts or to envision the scale of their swarms, there is an even greater challenge.

Not thirty years after the greatest outpouring of insect life ever witnessed by humans, the Rocky Mountain locust disappeared. The last living specimen was collected in 1902 on the Canadian prairie. We have much to learn from those who have passed before us. Scientists don't advocate seances, but if we listen carefully in the still, dark night of extinction, there is


much to hear. Gone for more than a century, the Rocky Mountain locust has lessons for us about the life and death of a species.

## Secrets in the Ice

In 1986, I was hired as an insect ecologist at the University of Wyoming to explore the world of grasshoppers, a mission I've undertaken for the past 18 years. No sane person would devote so much time to pursuing a subject that did not touch the heart and soul while stimulating the mind. Soon after arriving at the university, I learned that the accepted explanation for the Rocky Mountain locust's demise was a vague conspiracy of vast ecological changes. Entomologists proposed that the disappearance of bison, the decline of fires set by Native Americans, and changes in climate had altered the locust's prairie habitats. But when I started digging through the evidence, none of these factors provided a satisfactory explanation. Slowly I was being drawn into a mystery that was to become much more than a scientifically objectified inquiry.

The challenge of the whodunit was so enticing that I was compelled to reopen the case. Besides, I had a lead on a bounty of clues that had scarcely been touched. Digging through geological reports, I learned about the existence of "grasshopper glaciers" strung along the spine of the Rockies. These glaciers were named for their contents. If the frozen corpses were actually locusts, they might provide clues as to how these insects disappeared.

Our first ventures as entomological grave robbers were disappointing. My students and I started at Grasshopper Glacier, a natural wonder north of Cooke City, Montana, which had once been promoted as a tourist attraction. But by the late 1980s, the glacier had melted extensively and the insect remains were badly decomposed. Another Grasshopper Glacier in Montana's Crazy Mountains yielded beautifully



# Slowly, I was drawn into a mystery that was to become much more than a scientifically objectified inquiry.

preserved specimens, but they were no more than a few years old. For the next two years, we searched the ice plastered on the flank of Beartooth Peak. We found body parts of long-dead grasshoppers, and the fragments matched those of the Rocky Mountain locust. But we lacked the definitive evidence that could come only from whole bodies.

After years of fruitless searching, we received a tip from colleagues at Western Wyoming Community College. Knife Point Glacier in the Wind River Mountains of Wyoming held the mother lode—a frozen graveyard of intact bodies melting from the surface of the ice. Analysis of these centuries-old remains of the Rocky Mountain locust, combined with historical research and ecological sleuthing, allowed us to piece together the story of this remarkable creature—and to challenge basic tenets of conventional ecological wisdom.

## An Unconventional Life and Death

The standard textbooks of applied entomology suggest that insect outbreaks are evidence of a disturbed or out-of-balance ecosystem. From this Victorian perspective, a population outbreak or crash is a symptom of a troubled species. Not so with the Rocky Mountain locust. Erratic, even explosive, population dynamics did not indicate dysfunctionality—indeed, quite the opposite. The leitmotif of this insect was its phenomenal flights of reproductive fancy, with manic swarms sweeping over the Plains only to collapse subsequently

into pockets of exhausted survivors. Evidence of this extreme waxing and waning was embedded in the annual deposition layers of Knife Point Glacier, which revealed an ancient rhythm of locust outbreaks—the species' telltale heartbeat.

From the layers of locusts in the ice, we learned that the species had irrupted every 5-8 years for centuries. From its DNA, we learned that the Rocky Mountain locust was most closely related to Bruner's spurthroated grasshopper (*Melanoplus bruneri*) rather than to the long-suspected lesser migratory grasshopper (*Melanoplus sanguinipes*). Further analyses of the frozen locusts revealed that they fed on an enormous range of plants and were free of parasites as they dispersed from the mountains. The corpses revealed a great deal about the life of the locust but frustratingly little about its death, although genetic evidence indicated that the species had not been in a prolonged decline. Rather, it had been quite vigorous until its sudden and startling disappearance.

At the time of the locust's demise, there was no insecticide industry, just a few thousand settlers with horse-drawn plows. But how could a ragtag bunch of farmers tilling fertile pockets within the vast Great Plains and Rocky Mountains decimate a species whose swarms stretched from Canada to Mexico and from California to Iowa?

The answer came from the classroom rather than the laboratory. In preparing a course on insect population biology, I dug into the ecology of the monarch butterfly. Much like the locust in the late 1800s, this migratory species is now poised for extinction. How could

# Being an abundant, polyphagous, and highly mobile species is no guarantee against extinction.

a butterfly that fills roadsides and fields from Texas to Maine be in jeopardy? At the end of each summer, this species returns to a few pockets of montane forest above Mexico City to spend the winter. Loosed on these sanctuaries, a logging crew could inadvertently put an end to this magnificent butterfly in a matter of a few weeks.

Suddenly I understood. Like the monarch butterfly, the Rocky Mountain locust was tremendously vulnerable at certain times. Between outbreaks, it sought refuge in the river valleys of Wyoming and Montana—the same habitats that settlers had discovered were best suited for agriculture. To feed the burgeoning mining rowns, the farmers plowed the meadows, diverted streams for irrigation, and grazed livestock in riparian areas. Plows and cows unknowingly wiped out the locust's sanctuaries. So, the only pest insect ever driven to extinction was inadvertently defeated by humans who were unaware of what they had done.

The farmers of the Rockies, like those who slash and burn the tropics today, were not malicious. They were just too hungry, reckless, and powerful for the good of the native flora and fauna. Humans can be bulls in nature's china shop. We don't need modern technology

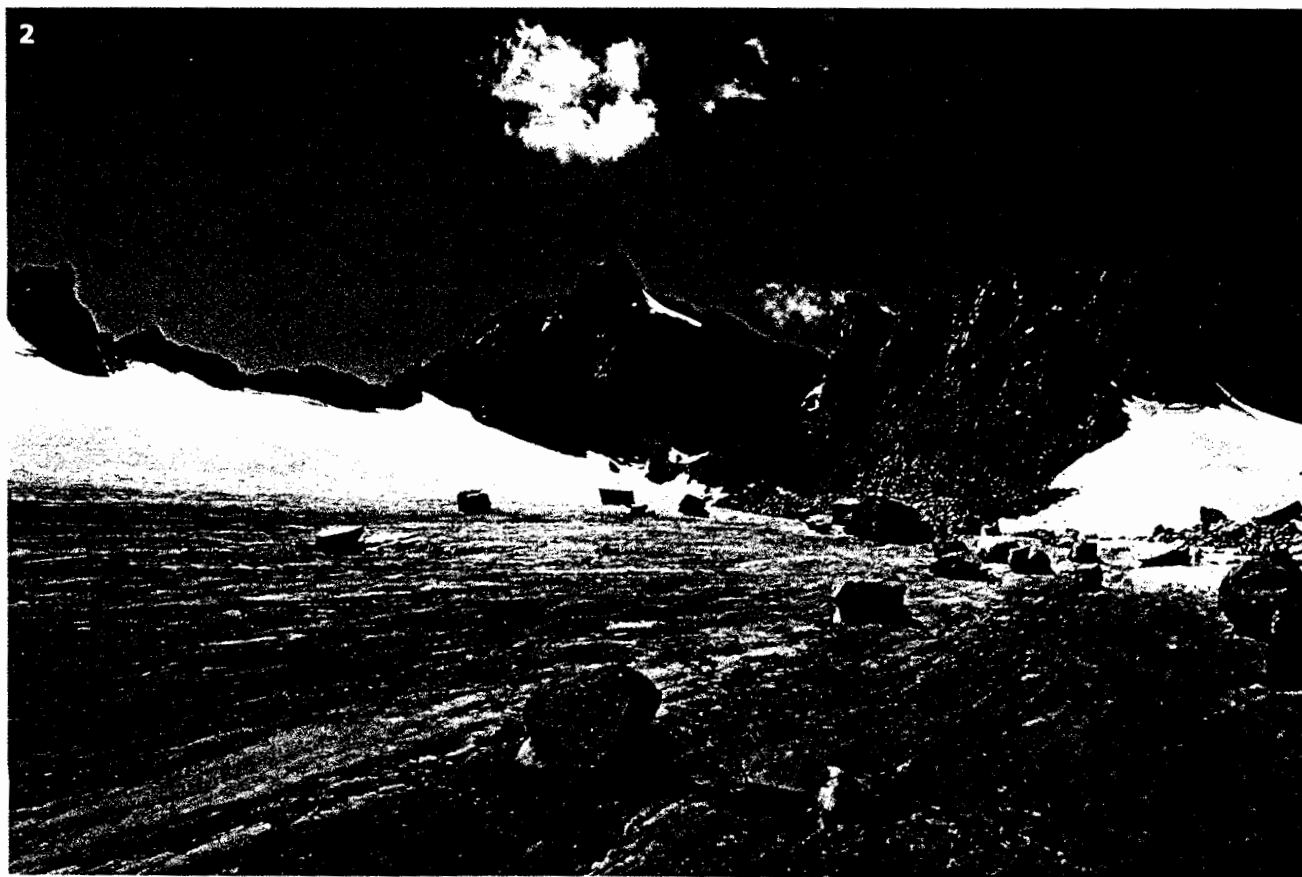
to wipe out a species. From the locust, we learned that a species is only as safe as its weakest link. And as a member of a species now numbering more than 6 billion individuals, I was sobered by another of the locust's teachings: being an abundant, polyphagous, and highly mobile species is no guarantee against extinction.

These were valuable lessons, but I wasn't satisfied. Kneeling on Knife Point Glacier, I'd held the mangled corpses of the once-glorious Rocky Mountain locust. I'd believed that touching the creature that had shaped the history and ecology of the West would provide some closure to a decades-long mystery. But I couldn't help wondering what it would be like to find an even more elusive quarry—to discover a pocket of survivors tucked away in some undisturbed mountain valley. In the course of this final quest, the Rocky Mountain locust would teach me perhaps its most important lesson.

## Days of the Living Dead

Away from the rim of Grand Canyon of the Yellowstone, the thundering falls and thronging

■ **1.** A 330-year old, well-preserved whole body of the extinct Rocky Mountain locust. ■ **2.** The specimen was recovered from Knife Point Glacier in the Wind River Range of Wyoming in August 1990. This glacier contains the only known intact bodies of this species, but a visit to the glacier this year revealed a phenomenal rate of recession—as much as 24 m of thickness over the last decade. A treasure trove of frozen history may have been lost. ■ **3.** The author searches for embedded remains of the Rocky Mountain locust by digging an ice pit in Grasshopper Glacier in the Crazy Mountains of central Montana in August 1988. Photos by Larry D. DeBrey



# A Species' Living Will

The notion of life-as-process might seem unusual in a society in which material existence is primary. But such a perception informs our deepest understanding of life. Indeed, life-as-process underlies our notion of euthanasia. When a loved one is simply a body devoid of the capacity to care, respond, or relate ever again in a way that we can recognize as being that individual, we understand that she is gone even before she is dead. Out of respect for individuals, we accept the terms of a living will. Perhaps we should accord similar respect to the integrity of species. Imagine assembling a team of biologists, naturalists, poets, and shamans to consider the essence of an endangered species. The resulting document might specify something such as:

I, *Melanoplus spretus*, want humans to try interventions that may return me to an acceptable quality of life. However, if my quality of life becomes unacceptable to me, I direct that interventions (including captive breeding, genetic engineering, artificial refuges, and zoological preservation) be withdrawn. A quality of life that is unacceptable to me means being unable to swarm, unable to recognize my habitat or species, and unable to feed on my native foods; and it includes total or near-total dependence on others for care.

tourists give way to murmuring breezes and teeming grasshoppers. Visitors come to Yellowstone National Park to glimpse a fiery underworld of fumaroles and geysers. I came hoping to see the remnants of a natural phenomenon that had not erupted for a hundred years. Captivated by the geothermal wonders, the U.S. Congress had designated Yellowstone as the country's first National Park in 1872. Congress did not mean to preserve the sanctuaries of the Rocky Mountain locust, from which the species exploded and flowed over an area larger than that of any volcanic eruption.

Kneeling in a meadow, holding a grasshopper between thumb and forefinger, and turning the struggling creature to get a better look at its features, I quickly concluded that I'd only managed to find one of the long-lost locust's taxonomic cousins. Gently tossing the insect back into the grass, I wondered: What if I succeeded—what if I found a pocket of habitat still harboring this incredible creature? What would this mean to me, to the locust, to science, and to society? I listened for an answer. And in the days to follow, the locust provided me with its last tutorial.

What makes a species "real" is the essential starting point of conservation biology. For the Rocky Mountain locust, it was the swarms or, more precisely, the *process* of swarming that defined this remarkable species. This perception of the locust's essence runs counter to the material terms in which we usually conceive the world. We normally define a species as a set of individuals with some shared qualities, typically the capacity to interbreed successfully. This orthodox definition equates being real with being made of matter; it presumes the metaphysics of materialism. In this light, a species is the sum total of its members, the



# The locust was comprised of trillions of bodies that washed over the continent like a living tsunami.

Rocky Mountain locust being comprised of trillions of bodies that washed over the continent like a living tsunami. But a wave is not water. Our sense that a wave is a mound of moving water is an illusion. The wave is the energy coursing through the fluid, while the fluid is merely the observable evidence of what surges within. A wave is no more water than wind is trembling aspen leaves.

Ecology is beginning slowly to shift focus by tentatively exploring what the world would look like if process rather than matter were the basis for reality. What if we defined a species in terms of its life processes? We might seriously doubt whether the monarch butterfly can be “conserved” within a refuge, a zoological garden, a vial of DNA, or a sequence of the letters A, T, C, and G. If this species could not cluster against the chill rains of winter and sprawl into the milkweed patches of summer, what would we have conserved? What if a thing *is* what it *does*? In this light, the Rocky Mountain locust was an immense, aperiodic energy flow that linked living systems across a continent.

And so it was that I came to understand that this species was truly extinct by the late 1800s. Its life ceased well before the last corporeal manifestation disappeared. Rocky Mountain locusts clinging to life within a fragment of habitat would no more be their original species than a colony of monarch butterflies flitting futilely within a glasshouse. Unless the locust could once again blacken the skies, it would in fact be something else—perhaps a Rocky Mountain grasshopper, but

not the Rocky Mountain locust. I finally understood that the species was gone forever and that nothing I could pull from my sweep net in the meadows of the Yellowstone could alter this reality.

**A**mong the grasshoppers I collected in Yellowstone National Park, I remember one female with spectacularly long wings. She lacked the distinctive yellow coloration on her underside that typifies the closest living relative of the Rocky Mountain locust—the usual “fool’s gold” of my quests. Intrigued, I captured several more specimens, including a male. Only males possess the tiny internal structures necessary for definitive identification. After a few minutes of gentle examination under my field lens, he slipped from my fingers. Because I did not remove the specimen from the park, his identity did not have to be reported to the authorities. To be absolutely sure, I would have needed to dissect the creature. But it wouldn’t have mattered anyway. Most people don’t believe you when you say you’ve seen a ghost. 🐛

---

**Jeffrey Lockwood** is a professor of Natural Sciences and Humanities at the University of Wyoming. The author of *Grasshopper Dreaming*, he has been awarded a Pushcart Prize as well as the 2003 John Burroughs Award.

This article is adapted from *Locust: The Devastating Rise and Mysterious Fall of the Insect That Shaped the American Frontier*, by Jeffrey A. Lockwood, and from Lockwood, J. “The Death of the Super Hopper,” *High Country News*, February 3, 2003.